LAMPIRAN I

PERHITUNGAN

PERHITUNGAN

1. Perhitungan Desain Evaporator Vakum

a. Desain Proses

Diketahui :

Volume tangki (Presto) = 8 dm^3

Diameter = 24 cm = 2,4 dm

Maka,

$$V = \frac{\pi}{4} D^2 H$$

$$8000\ cm^3 = \frac{3,14}{4} (2,4\ cm)^2 . H$$

$$H = 17,6929\ cm = 6,9657 \in ¿$$

Jadi,

Tangki dirancang sehingga 80% volumenya berisi reaktan.

$$V\ cairan = \frac{V\ tangki}{20}$$

$$V\ cairan = \frac{8\ \frac{100\ dm^3}{}}{80}$$

$$V\ cairan = \frac{640\ \frac{dm^3}{}}{100}$$

$$V\ cairan = 6,4\ dm^3$$

Jadi, tinggi tangki (H) sebesar 17,6929 cm dan volume cairan sebesar 6,4 dm^3.

Tinggi cairan

$$HL = \frac{V\ cairan}{\frac{\pi D^2}{4}}$$

$$V\ cairan = \frac{\pi}{4} D^2 HL$$

$$6,4\ dm^3 = \frac{3,14}{4} x\ (2,4\ dm)^2 \text{ x HL}$$

HL = 1,41543 dm

HL = 14,1543 cm = 5,5726 in = 0,4644 ft

b. Desain Mekanikal

Reaktor beroperasi pada tekanan di bawah atmosferis.

Asumsi :

$$\rho = \frac{m}{v} = \frac{8000\ gr}{8000\ cm^3} = 1\ gr/cm^3 = 62{,}428\ lb/ft^3$$

Tekanan hidrostatis di dasar reaktor disebabkan oleh adanya cairan di dalam reaktor.

Ph = ρgh

Dimana:

Ph = tekanan hidrostatis dalam reaktor, Psi

ρ = massa jenis cairan dalam reaktor, lb/ft^3

h = tinggi *level* cairan dalam reaktor, ft

$$g = \frac{g}{gc} = \frac{32{,}179\ ft/det^2}{32{,}1740\ lbft/lb\ s^2} = 1$$

$$Ph = \rho gh = 62{,}428\ lb/ft^3 \times 1 \times 0{,}4644\ ft = 28{,}9916\ lb/ft^2$$

$$= 0{,}20133\ Psi$$

P diasumsikan = 0,6 atm = 8,8176 Psi

P operasi = P_h + P

= 0,20133 Psi + 8,8176 Psi

= 9,01893 Psi = 0,613701 atm

Tekanan desain 5-10% di atas tekanan kerja absolut (*Coulson, 1988:637*)

Desain Tekanan di *set* 10 % di atas tekanan operasi.(*Walas, 1988:xviii*)

P desain = (110%)(9,01893 Psi)

= 9,9208 Psi = 68,4015 KN/ m^2

Tebal *Shell*

Untuk mencari tebal *shell*, digunakan persamaan berikut.

$$t_s = \frac{P \,.\, ri}{f \,.\, E - 0{,}6\, P + C}$$ (Rase *and* Barrow, 1957)

Dengan,

t_s = Tebal *shell*

P = Tekanan desain

ri = jari-jari

f = *Allowable working stress*

E = *joint efficiency*

C = *Corrosion allowance*

Material = *Stainless Steel*

Working Stress, (f) = 129276,7 KN/m^2.

Joint Efficiency, (E) = 0,8

(Tabel 13.2, Brownell, 1959:254)

Internal Radius, (ri) = D/2 =8,35 in/2 = 4,175 in

=0,106045 m

Corrosion allowance = 0,125 in = 0,003175 m

(Tabel 6, Timmerhaus, 1991:542)

$$t_s = \frac{P \,.\, ri}{f \,.\, E - 0{,}6\, P + C}$$

$$= \frac{68{,}4015 \frac{KN}{m^2} \, x \, 0{,}12 m}{\left(129276{,}7 \frac{KN}{m^2} \, x \, 0{,}8\right) - \left(0{,}6 \, x \, 68{,}4015 \frac{KN}{m^2}\right)} + 0{,}003175 \text{ m}$$

= 0,0032544 m =3,2544 mm = 0,12813 in

maka *outside diameter* (OD) = $D_i + 2 \quad t_s$

= 9,4488 in + (2 x 0,12813in)

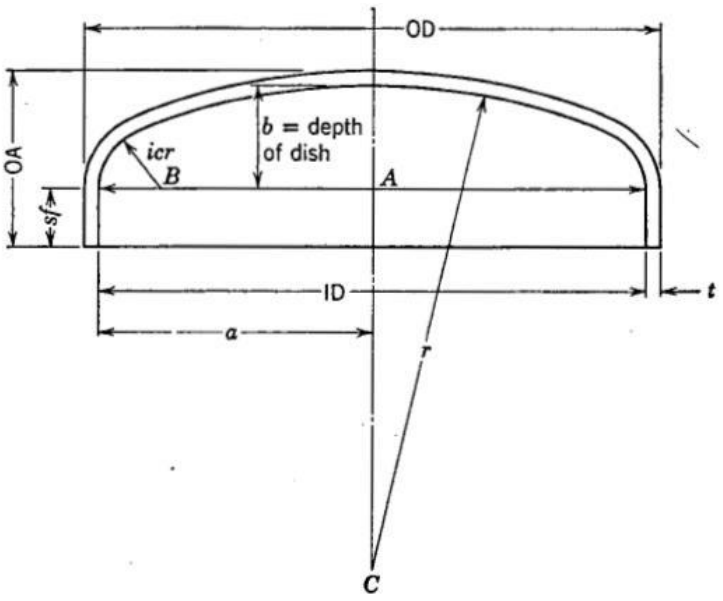
= 9,70508 in = 24,6509 cm

Diambil OD standar = 12 in (Brownell *and* Young, 1959:91)

c. Perancangan *Head* Tangki

Bentuk : *Flanged and Standard Dished Head*

Dasar Pemilihan : Digunakan untuk tangki vertikal bertekanan rendah (< 1 atm), terutama untuk tangki penyimpanan horizontal, serta menyimpan fluida yang volatil (Brownell *and* Young, 1959:91).



Menentukan dimensi tutup atas dan bawah

$$th = \frac{P . r_c . W}{2 f . E - 0{,}2 P} + C$$ (Brownell *and* Young, 1959:91)

Ketebalan = OD – ID

= 9,70508 – 9,4488

= 0,25626 in

= 6,5090 mm

Sehingga diperoleh:

r = 12 in (jari-jari *dish*, in)

icr = ¾ (jari-jari sudut dalam, in) (Tabel 5.7, Brownell, 1959:89)

$$W = \frac{1}{4} x \left(\sqrt{3 + \frac{rc}{icr}} \right)$$

$$W = \frac{1}{4} \sqrt{\frac{12}{\frac{3}{4}}} \left(3+\right)$$

$W = 1{,}75 \in$¿ = 0,04445 m

maka,

$$th = \frac{P \,.r_c\,.\, W}{2\,f\,.\,E - 0{,}2\,P} + C$$

$$9{,}9208\ psi \times 1{,}75 \in \frac{\text{¿}}{(2 \times 18750 \times 0{,}8) - (0{,}2 \times 9{,}9208)} + 0{,}125 \in \text{¿}$$

$th =$¿

$$th = \frac{68{,}4015\ KN/m^2 \times 0{,}04445\ m}{(2 \times 69{,}3169\ KN/m^2 \times 0{,}8) - (0{,}2 \times 68{,}4015\ KN/m^2)} + 0{,}003175\ m$$

$th = 0{,}031272 + 0{,}003175\ m$

$th = 0{,}03445\ m$

$th = 1{,}3563 inci$

Dipakai plat dengan tebal standar 1 3/8 in

sehingga didapat nilai Sf standar = 3,5 in (Tabel 5.4, Brownell, 1959:87)

$9{,}4488 \in 3{,}5$¿ =2,6997 ∈¿

$a = 3{,}5^{ID}$ =¿

$9{,}4488 \in 3{,}5$¿ – $\frac{3}{4}$

$AB = 3{,}5^{\frac{ID}{}} - irc =$¿

¿ 1,9497 ∈¿

$BC = r - irc = 12 - \frac{3}{4} = \frac{48-3}{4} = 11{,}25 \in$¿

$AC = \sqrt{BC^2 - AB^2}$

$AC = \sqrt{11{,}25^2 - 1{,}9497^2}$

$AC = 11{,}0798 \in$¿

b = r – AC = 12 in – 11,0798 in = 0,9202 in

$OA = b + th + Sf$

$OA = 0{,}9202 + 1{,}3563 + 3{,}5$

$OA = 5{,}7765 \in$¿

jadi,

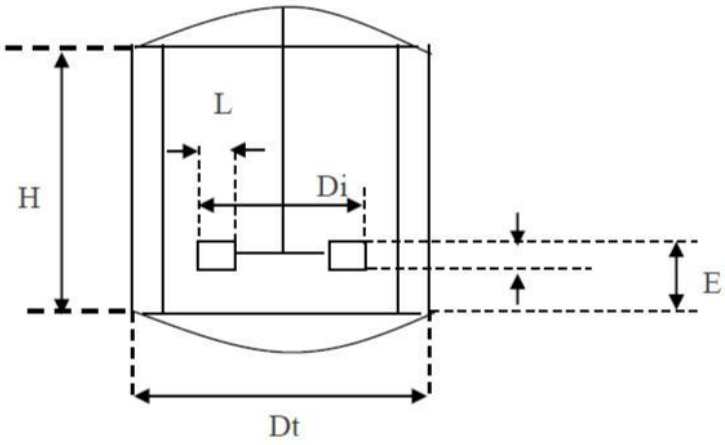
Tinggi Evaporator=Tinggi head +Tinggi shell

¿ 5,7765∈+6,9657 ∈¿

¿ 12,7422∈¿

¿32,3652 *cm*

d. Perancangan Pengaduk



Data pengadukan diperoleh dari Brown "*Unit Operation*" hal 507:

Di/ID = 1/3 B/ID = 1/12 W/Di = 1/5 E/Di = 1 L/Di

= 1/4

Ukuran Pengaduk:

Diameter Pengaduk (Di)

$$Di = \frac{ID}{3} = \frac{24\ cm}{3} = 8\ cm$$

Lebar Padel (W)

$$W = \frac{Di}{5} = \frac{8\ cm}{5} = 1{,}6\ cm$$

Panjang Padel (L)

$$L = \frac{Di}{4} = \frac{8\ cm}{4} = 2cm$$

Lebar *Baffle* (B)

$$B = \frac{ID}{12} = \frac{24}{12} cm = 2\ cm$$

Jarak Pengaduk dengan Dasar (E)

$$\frac{E}{Di} = 0{,}75 - 1{,}3 \quad : \text{dipilih } 1$$

$$E = 1\ x\ Di = 1\ x\ 8\ cm = 8\ cm$$

2. Perhitungan Penentuan Viskositas Sirup

Diketahui :

Beratp piknometer kosong = 37,4447 gr

Berat piknometer + Air = 62,0073 gr

ρ. Air = 0,997 gr/cm^3

$$V\ .\ piknometer = \frac{B - A}{\rho.\ Air}$$

$$¿ \frac{62{,}0073\ gr - 37{,}4447\ gr}{0{,}997\ gr\ /cm^3}$$

$$¿ 24{,}6365\ cm^3$$

Temperatur (₀C)	Waktu (menit)	Lama Bola Turun (detik)	Berat Piknometer + Sirup (gr)
45	30	12,47	66,8615
	60	13,47	67,1978
	90	15,40	66,9019
	120	16,18	67,5925
50	30	12,84	67,0197
	60	13,99	67,3125
	90	15,70	67,2516
	120	19,84	67,1684
55	30	7,61	65,8585
	60	10,87	66,3470
	90	19,28	67,1574
	120	22,87	67,7100

Rumus :

- Viskositas Dinamik

$$= k\ (\ _1 - \ _2)\ t$$

- Viskositas Kinematik

$$v = \frac{\mu}{\rho}$$

a. Sampel 1 (45^{o}C, 30 Menit)

Diketahui : $_1$ = 8,1 g/cm^3

$$_2 = \frac{(66{,}8615 - 37{,}4447)\ gr}{24{,}6365\ cm^3} = 1{,}1940\ g/cm^3$$

k = 0,09 mPa.s cm^3/gr.s

- Viskositas Dinamik
  = (0,09 mPa.s cm$_3$/gr.s) (8,1 g/cm^3 - 1,1940 g/cm^3)(12,47 s) =
  (0,09 mPa.s cm$_3$/gr.s) (6,906 g/cm^3)(12,47 s)
  = 7,7506 mPa.s
  = 7,7506 cp.

- Viskositas Kinematik

$$v = \frac{7{,}7506\ mPa\ .\ s}{1{,}1940\ g/cm^3}$$

v = 6,4913 mm^2/s

b. Sampel 2 (45^{o}C, 60 Menit)
Diketahui : $_1$ = 8,1 g/cm^3

$$_2 = \frac{(67{,}1978 - 37{,}4447)\ gr}{24{,}6365\ cm^3} = 1{,}2077\ g/cm^3$$

k = 0,09 mPa.s cm^3/gr.s

- Viskositas Dinamik
  = (0,09 mPa.s cm$_3$/gr.s) (8,1 g/cm^3 - 1,2077 g/cm^3)(13,47 s)
  = (0,09 mPa.s cm$_3$/gr.s) (6,8294 g/cm^3)(13,47 s)
  = 8,3555 mPa.s
  = 8,3555 cp.

- Viskositas Kinematik

$$v = \frac{8{,}3555\ mPa\ .\ s}{1{,}2077\ g/cm^3}$$

v = 6,9185 mm^2/s

c. Sampel 3 (45^{o}C, 90 Menit)
Diketahui : $_1$ = 8,1 g/cm^3

$$_2 = \frac{(66{,}9019 - 37{,}4447)\ gr}{24{,}6365\ cm^3} = 1{,}1957\ g/cm^3$$

k = 0,09 mPa.s cm^3/gr.s

- Viskositas Dinamik
  = (0,09 mPa.s cm$_3$/gr.s) (8,1 g/cm^3 - 1,1957 g/cm^3)(15,40 s)
  = (0,09 mPa.s cm$_3$/gr.s) (6,9043 g/cm^3)(15,40 s)
  = 9,5694 mPa.s
  = 9,5694 cp.

- Viskositas Kinematik

$$v = \frac{9{,}5694\ mPa\,.\,s}{1{,}1957\ g/cm^3}$$

$v = 8{,}0032\ mm^2/s$

d. Sampel 4 (45^oC, 120 Menit)

Diketahui : $\rho_1 = 8{,}1\ g/cm^3$

$$\rho_2 = \frac{(67{,}5925 - 37{,}4447)\ gr}{24{,}6365\ cm^3} = 1{,}2237\ g/cm^3$$

$k = 0{,}09\ mPa.s\ cm^3/gr.s$

- Viskositas Dinamik

$= (0{,}09\ mPa.s\ cm^3/gr.s)\ (8{,}1\ g/cm^3 - 1{,}2237\ g/cm^3)(16{,}18\ s)$

$= (0{,}09\ mPa.s\ cm^3/gr.s)\ (6{,}8763\ g/cm^3)(16{,}18\ s)$

$= 10{,}0133\ mPa.s$

$= 10{,}0133\ cp.$

- Viskositas Kinematik

$$v = \frac{10{,}0133\ mPa\,.\,s}{1{,}2237\ g/cm^3}$$

$v = 8{,}1828\ mm^2/s$

e. Sampel 5 (50^oC, 30 Menit)

Diketahui : $\rho_1 = 8{,}1\ g/cm^3$

$$\rho_2 = \frac{(67{,}0197 - 37{,}4447)gr}{24{,}6365\ cm^3} = 1{,}20045\ g/cm^3$$

$k = 0{,}09\ mPa.s\ cm^3/gr.s$

- Viskositas Dinamik

$= (0{,}09\ mPa.s\ cm^3/gr.s)\ (8{,}1\ g/cm^3 - 1{,}20045\ g/cm^3)(12{,}84\ s)$

$= (0{,}09\ mPa.s\ cm^3/gr.s)\ (6{,}84114\ g/cm^3)(12{,}84\ s)$

$= 7{,}9731\ mPa.s$

$= 7{,}9731\ cp.$

- Viskositas Kinematik

$$v = \frac{7{,}9731\ mPa\,.\,s}{1{,}20045\ g/cm^3}$$

$v = 6{,}6418\ mm^2/s$

f. Sampel 6 (50^oC, 60 Menit)

Diketahui : $\rho_1 = 8{,}1\ g/cm^3$

$$\rho_2 = \frac{(67{,}3125 - 37{,}4447)\ gr}{24{,}6365\ cm^3} = 1{,}2123\ g/cm^3$$

k = 0,09 mPa.s cm^3/gr.s

- Viskositas Dinamik
  = (0,09 mPa.s cm_3/gr.s) (8,1 g/cm^3 - 1,2123 g/cm^3)(13,99 s)
  = (0,09 mPa.s cm_3/gr.s) (6,8877 g/cm^3)(13,99 s)
  = 8,6723 mPa.s
  = 8,6723 cp.

- Viskositas Kinematik

$$v = \frac{8,6723\ mPa.s}{1,2123\ g/cm^3}$$

v = 7,1536 mm^2/s

g. Sampel 7 (50^{o}C, 90 Menit)
Diketahui : $_1$ = 8,1 g/cm^3

$$_2 = \frac{(67,2516-37,4447)gr}{24,6365\ cm^3} = 1,2099\ g/cm^3$$

k = 0,09 mPa.s cm^3/gr.s

- Viskositas Dinamik
  = (0,09 mPa.s cm_3/gr.s) (8,1 g/cm^3 - 1,2099 g/cm^3)(15,70 s)
  = (0,09 mPa.s cm_3/gr.s) (6,8901 g/cm^3)(15,70 s)
  = 9,7357 mPa.s
  = 9,7357 cp.

- Viskositas Kinematik

$$v = \frac{9,7357\ mPa.s}{1,2099\ g/cm^3}$$

v = 8,0467 mm^2/s

h. Sampel 8 (50^{o}C, 120 Menit)
Diketahui : $_1$ = 8,1 g/cm^3

$$_2 = \frac{(67,1684-37,4447)gr}{24,6365\ cm^3} = 1,2065\ g/cm^3$$

k = 0,09 mPa.s cm^3/gr.s

- Viskositas Dinamik
  = (0,09 mPa.s cm_3/gr.s) (8,1 g/cm^3 - 1,2065 g/cm^3)(19,84 s)
  = (0,09 mPa.s cm_3/gr.s) (6,8935 g/cm^3)(19,84 s)
  = 12,3090 mPa.s
  = 12,3090 cp.

- Viskositas Kinematik

$$v = \frac{12{,}3090\ mPa\ .\ s}{1{,}2065\ g/cm^3}$$

$v = 10{,}2022\ mm^2/s$

i. Sampel 9 (55^oC, 30 Menit)
Diketahui : $\rho_1 = 8{,}1\ g/cm^3$

$$\rho_2 = \frac{(65{,}8585 - 37{,}4447)\ gr}{24{,}6365\ cm^3} = 1{,}1533\ g/cm^3$$

$k = 0{,}09\ mPa.s\ cm^3/gr.s$

- Viskositas Dinamik
  $= (0{,}09\ mPa.s\ cm^3/gr.s)\ (8{,}1\ g/cm^3 - 1{,}1533\ g/cm^3)(7{,}61\ s)$
  $= (0{,}09\ mPa.s\ cm^3/gr.s)\ (6{,}9467\ g/cm^3)(7{,}61\ s) =$
  $4{,}7578\ mPa.s$
  $= 4{,}7578\ cp.$

- Viskositas Kinematik

$$v = \frac{4{,}7578\ mPa\ .\ s}{1{,}1533\ g/cm^3}$$

$v = 4{,}1254\ mm^2/s$

j. Sampel 10 (55^oC, 60 Menit)
Diketahui : $\rho_1 = 8{,}1\ g/cm^3$

$$\rho_2 = \frac{(66{,}3470 - 37{,}4447)\ gr}{24{,}6365\ cm^3} = 1{,}1731\ g/cm^3$$

$k = 0{,}09\ mPa.s\ cm^3/gr.s$

- Viskositas Dinamik
  $= (0{,}09\ mPa.s\ cm^3/gr.s)\ (8{,}1\ g/cm^3 - 1{,}1731\ g/cm^3)(10{,}87$
  $s)$
  $= (0{,}09\ mPa.s\ cm^3/gr.s)\ (6{,}9269\ g/cm^3)(10{,}87\ s)$
  $= 6{,}7766\ mPa.s$
  $= 6{,}7766\ cp.$

- Viskositas Kinematik

$$v = \frac{6{,}7766\ mPa\ .\ s}{1{,}1731\ g/cm^3}$$

$v = 5{,}7767\ mm^2/s$

k. Sampel 11 (55^oC, 90 Menit)
Diketahui : $\rho_1 = 8{,}1\ g/cm^3$

$$\rho_2 = \frac{(67{,}1574 - 37{,}4447)gr}{24{,}6365\ cm^3} = 1{,}2060\ g/cm^3$$

$k = 0{,}09\ mPa.s\ cm^3/gr.s$

- Viskositas Dinamik

= (0,09 mPa.s cm_3/gr.s) (8,1 g/cm^3 - 1,2060 g/cm^3)(19,28 s)
= (0,09 mPa.s cm_3/gr.s) (6,894 g/cm^3)(19,28 s)
= 11,9625 mPa.s
= 11,9625 cp.

- Viskositas Kinematik

$$v = \frac{11{,}9625\ mPa\,.\,s}{1{,}2\,060\ g/cm^3}$$

v = 9,9192 mm^2/s

l. Sampel 12 (55^{o}C, 120 Menit)
Diketahui : $_1$ = 8,1 g/cm^3

$$_2 = \frac{(67{,}7100 - 37{,}4447)\ gr}{24{,}6365\ cm^3} = 1{,}2285\ g/cm^3$$

k = 0,09 mPa.s cm^3/gr.s

- Viskositas Dinamik
= (0,09 mPa.s cm_3/gr.s) (8,1 g/cm^3 - 1,2285 g/cm^3)(22,87 s)
= (0,09 mPa.s cm_3/gr.s) (6,8715 g/cm^3)(22,87 s)
= 14,1436 mPa.s
= 14,1436 cp.

- Viskositas Kinematik

$$v = \frac{14{,}1436\ mPa\,.\,s}{1{,}2285\ g/cm^3}$$

v = 11,5129 mm^2/s

3. Perhitungan Organoleptik

a. Organoleptik terhadap
Rasa Diketahui :

Kode Panelis	Perlakuan A1	A2	A3	Jumlah (∑Y)
P1	3	3	4	10
P2	4	4	3	11
P3	4	3	3	10
P4	4	3	3	10
P5	4	3	3	10
P6	4	3	1	8
P7	4	3	4	11
P8	4	3	4	11
Kode Panelis	**Perlakuan A1**	**A2**	**A3**	**Jumlah (∑Y)**

P9	2	2	3	7
P10	4	4	4	12
P11	3	3	3	9
P12	3	3	3	9
P13	2	3	3	8
P14	4	3	3	10
P15	4	3	3	10
P16	2	2	3	7
P17	3	3	2	8
P18	3	3	2	8
P19	3	4	2	9
P20	3	4	2	9
P21	3	4	4	11
P22	3	3	2	8
P23	4	4	4	12
P24	3	3	3	9
P25	4	4	2	10
P26	2	2	3	7
P27	4	3	3	10
P28	3	4	3	10
P29	3	2	3	8
P30	3	3	2	8
P31	3	3	3	9
P32	3	3	4	10
Total	100	105	94	229

$A1_2$	**$A2_2$**	**$A3_2$**	**Jumlah (∑Y^2)**
9	9	16	34
16	16	9	41
9	16	9	34
9	16	9	34
9	16	9	34
9	16	1	26
9	16	16	41
9	16	16	41
4	4	9	17
16	16	16	48
9	9	9	27
9	9	9	27

$A1_2$	**$A2_2$**	**$A3_2$**	**Jumlah (∑Y^2)**
9	4	9	22
9	16	9	34

9	16	9	34
4	4	9	17
9	9	4	22
9	9	4	22
16	9	4	29
16	9	4	29
16	9	16	41
9	9	4	22
16	16	16	48
9	9	9	27
16	16	4	36
4	4	9	17
9	16	9	34
16	9	9	34
4	9	9	22
9	9	4	22
9	9	9	27
9	9	16	34
324	359	294	977

N = 96

k = 3 n

= 32

Ditanya : F_{Tabel} ?

Penyelesaian :

dbK = k – 1

= 3 – 1

= 2

dbG = N – k

= 96 –

3 =93

dbT = N – 1

= 96 – 1

= 95

$$\sum_{¿}^{Yt} ¿¿^2$$

$$\sum_{¿}^{Y} ¿¿^2$$

$$JKK = ¿ \left(\frac{100}{32^2} + \frac{105}{32^2} + \frac{94}{32^2}\right) - \frac{299}{96}^2$$

¿1,8958

$$JKT = \sum_{¿}^{Y} Y^2 - ¿$$

$$¿977 - \frac{299}{96}^2$$

¿45,7396

$$JKG = JKT - JKK$$

¿45,7396−1,8958

¿43,8438

$$KTK = \frac{JKK}{dbK}$$

$$¿\frac{1,8958}{2}$$

¿0,9479

$$KTG = \frac{JKG}{dbG}$$

$$¿\frac{43,8438}{93}$$

¿0,4714

$$F\ hitung = \frac{KTK}{KTG}$$

$$¿\frac{0,9479}{0,4714}$$

¿2,01

F_{Tabel} = 3,09 (diperoleh dari Tabel F 0,05, halaman 54)
$F_{Hitung} < F_{Tabel}$

b. Organoleptik terhadap
Aroma Diketahui :

Kode Panelis	Perlakuan			Jumlah (∑Y)
	A1	A2	A3	
P1	2	2	2	6
P2	1	3	4	8

Kode Panelis	Perlakuan			Jumlah (∑Y)
	A1	A2	A3	
P3	2	2	2	6
P4	1	1	1	3
P5	2	1	2	5
P6	1	1	1	3
P7	2	2	4	8
P8	3	2	4	9
P9	1	1	2	4
P10	2	2	2	6
P11	2	2	2	6
P12	1	2	1	4
P13	2	2	3	7
P14	2	1	1	4
P15	3	2	3	8
P16	1	2	2	5
P17	1	1	1	3
P18	1	1	1	3
P19	1	1	1	3
P20	1	2	3	6
P21	2	2	1	5
P22	1	2	1	4
P23	3	3	3	9
P24	1	1	3	5
P25	2	2	3	7
P26	1	3	1	5
P27	2	1	2	5
P28	1	2	3	6
P29	2	3	3	8

P30	2	1	1	4
P31	2	2	3	7
P32	1	2	4	7
Total	52	57	70	179

A1$_2$	**A2$_2$**	**A3$_2$**	**Jumlah (∑Y^2)**
4	4	4	12
1	9	16	26
4	4	4	12
1	1	1	3
4	1	4	9

A1$_2$	**A2$_2$**	**A3$_2$**	**Jumlah (∑Y^2)**
1	1	1	3
4	4	16	24
9	4	16	29
1	1	4	6
4	4	4	12
4	4	4	12
1	4	1	6
4	4	9	17
4	1	1	6
9	4	9	22
1	4	4	9
1	1	1	3
1	1	1	3
1	1	1	3
1	4	9	14
4	4	1	9
1	4	1	6
9	9	9	27
1	1	9	11
4	4	9	17
1	9	1	11
4	1	4	9
1	4	9	14
4	9	9	22
4	1	1	6
4	4	9	17
1	4	16	21
79	83	139	301

N = 96

k = 3
n = 32
Ditanya : F_{Tabel} ?
Penyelesaian :
dbK = k – 1
= 3 – 1
= 2
dbG = N – k
= 96 –
3 =93
dbT = N – 1
= 96 – 1
= 95

$$JKK = \sum_{}^{} \frac{Yt^2}{} - \frac{Y^2}{}$$

$$= \left(\frac{52^2}{32} + \frac{57^2}{32} + \frac{70^2}{32}\right) - \frac{179^2}{96}$$

$$= 5,3958$$

$$JKT = \sum_{}^{} Y^2 - \frac{Y^2}{}$$

$$= 301 - \frac{299^2}{96}$$

$$= -32,7604$$

$$JKG = JKT - JKK$$
$$= -32,7604 - 5,3958$$
$$= -38,1563$$

$$KTK = \frac{JKK}{dbK}$$

$$¿ \frac{5,3958}{2}$$

$$¿ 2,6979$$

$$KTG = \frac{JKG}{dbG}$$

$$¿ \frac{-38,1563}{93}$$

$$¿ -0,4103$$

$$F\,hitung = \frac{KTK}{KTG}$$

$$¿ = \frac{2,6979}{0,4103}$$

$$¿ -6,58$$

F_{Tabel} = 3,09 (diperoleh dari Tabel F 0,05, halaman 54)
$F_{Hitung} < F_{Tabel}$

c. Organoleptik terhadap
Warna Diketahui :

Kode Panelis	Perlakuan			Jumlah (∑Y)
	A1	A2	A3	
P1	1	2	3	6
P2	1	3	1	5
P3	2	3	2	7
P4	2	2	2	6
P5	3	2	3	8
P6	3	2	2	7
P7	3	3	3	9
P8	3	3	3	9
P9	2	3	2	7
P10	3	3	3	9
P11	2	2	2	6
P12	2	2	1	5
P13	3	2	3	8
P14	2	2	1	5
P15	4	3	3	10
P16	1	2	2	5

P17	2	2	2	6
P18	3	3	2	8
P19	4	4	2	10
P20	2	3	1	6
P21	2	3	2	7
P22	2	3	2	7
P23	3	3	2	8
P24	1	3	1	5
P25	2	3	1	6
P26	1	3	2	6
P27	2	2	2	6
P28	2	2	1	5
P29	2	2	2	6
P30	2	3	1	6
P31	2	3	2	7
P32	3	3	3	9
Total	72	84	64	220

A1$_2$	**A2$_2$**	**A3$_2$**	**Jumlah (∑Y^2)**
1	4	9	14
1	9	1	11
4	9	4	17
4	4	4	12
9	4	9	22
9	4	4	17
9	9	9	27
9	9	9	27
4	9	4	17
9	9	9	27
4	4	4	12
4	4	1	9
9	4	9	22
4	4	1	9
16	9	9	34
1	4	4	9
4	4	4	12
9	9	4	22
16	16	4	36

4	9	1	14
4	9	4	17
4	9	4	17
9	9	4	22
1	9	1	11
4	9	1	14
1	9	4	14
4	4	4	12
4	4	1	9
4	4	4	12
4	9	1	14
4	9	4	17
9	9	9	27
182	230	144	556

N = 96

k = 3 n

= 32

Ditanya : F_{Tabel} ?

Penyelesaian :

dbK = k – 1

= 3 – 1

= 2

dbG = N – k

= 96 –

3 =93

dbT = N – 1

= 96 – 1

= 95

$$JKK = \left(\frac{72}{32^2} + \frac{84}{32^2} + \frac{64}{32^2}\right) - \frac{220}{96}^2$$

¿6,3333

$$JKT = \sum Y^2 - \frac{\sum Y^2}{}$$

¿556− $\frac{220}{}$ 96^2

¿51,8333

$JKG = JKT - JKK$

¿51,8333−6,3333

¿45,5000

$$KTK = \frac{JKK}{dbK}$$

¿$\frac{6,3333}{2}$

¿3,1667

$$KTG = \frac{JKG}{dbG}$$

¿$\frac{45,5000}{93}$

¿0,4892

$$F\,hitung = \frac{KTK}{KTG}$$

¿$\frac{3,1667}{0,48923}$

¿6,47

F_{Tabel} = 3,09 (diperoleh dari Tabel F 0,05, halaman 54)

$F_{Hitung} > F_{Tabel}$

KEMENTERIAN RISET, TEKNOLOGI DAN PENDIDIKAN TINGGI
POLITEKNIK NEGERI SRIWIJAYA
LABORATORIUM TEKNIK KIMIA
Jalan Srijaya Negara, PALEMBANG 30139
Telp 0711-353414 ekt. 113 Fax. 0711-355918. E-mail : kimia@polsri.ac.id.

Lampiran STU Nomor : 86/PL6.I.14.1/A/2019

Perhitungan Penentuan Antioksidan

Rumus yang digunakan untuk menentukan % antioksidan :

$$\% \text{ Antioksidan} = \frac{\text{Absorbansi blanko} - \text{Absorbansi sampel}}{\text{Absorbansi blanko}} \text{ x } 100\%$$

Sampel 1 (Variasi 45°C, 30 Menit)

$$\% \text{ Antioksidan} = \frac{1{,}00680 - 0{,}99840}{1{,}00680} \text{x } 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}0084}{1{,}00680} \text{x } 100 \%$$

%Antioksidan = 0,8343 %

Sampel 2 (Variasi 45°C, 60 Menit)

$$\% \text{ Antioksidan} = \frac{1{,}00680 - 0{,}71797}{1{,}00680} \text{x } 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}28883}{1{,}00680} \text{x } 100 \%$$

% Antioksidan = 28,6879 %

Sampel 3 (Variasi 45°C, 90 Menit)

$$\% \text{ Antioksidan} = \frac{1{,}00680 - 0{,}28316}{1{,}00680} \text{x } 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}72364}{1{,}00680} \text{x } 100 \%$$

% Antioksidan = 71,8755 %

Sampel 4 (Variasi 45°C, 120 Menit)

$$\% \text{ Antioksidan} = \frac{1{,}00680 - 0{,}60655}{1{,}00680} \times 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}40025}{1{,}00680} \times 100\ \%$$

$$\% \text{ Antioksidan} = 39{,}7547\ \%$$

Sampel 5 (Variasi 50°C, 30 Menit)

$$\% \text{ Antioksidan} = \frac{1{,}00680 - 0{,}68821}{1{,}00680} \times 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}31859}{1{,}00680} \times 100\ \%$$

$$\% \text{ Antioksidan} = 31{,}6438\ \%$$

Sampel 6 (Variasi 50°C, 60 Menit)

$$\% \text{ Antioksidan} = \frac{1{,}00680 - 0{,}33566}{1{,}00680} \times 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}67113}{1{,}00680} \times 100\ \%$$

$$\% \text{ Antioksidan} = 60{,}3950\ \%$$

Sampel 7 (Variasi 50°C, 90 Menit)

$$\% \text{ Antioksidan} = \frac{1{,}00680 - 0{,}54701}{1{,}00680} \times 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}45979}{1{,}00680} \times 100\ \%$$

$$\% \text{ Antioksidan} = 45{,}6685\ \%$$

Sampel 8 (Variasi 50°C, 120 Menit)

$$\% \text{ Antioksidan} = \frac{1{,}00680 - 0{,}67658}{1{,}00680} \times 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}33022}{1{,}00680} \times 100\ \%$$

$$\% \text{ Antioksidan} = 32{,}7990\ \%$$

Sampel 9 (Variasi 55°C, 30 Menit)

$$\% \text{ Antioksidan} = \frac{1{,}00680 - 0{,}43578}{1{,}00680} \times 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}57102}{1{,}00680} \times 100\ \%$$

$$\% \text{ Antioksidan} = 56{,}7163\ \%$$

Sampel 10 (Variasi 55°C, 60 Menit)

$$\% \text{ Antioksidan} = \frac{1{,}00680 - 0{,}35325}{1{,}00680} \times 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}65355}{1{,}00680} \times 100\ \%$$

$$\% \text{ Antioksidan} = 64{,}9136\ \%$$

Sampel 11 (Variasi 55°C, 90 Menit)

$$\% \text{ Antioksidan} = \frac{1{,}00680 - 0{,}43549}{1{,}00680} \times 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}57131}{1{,}00680} \times 100\ \%$$

$$\% \text{ Antioksidan} = 56{,}7451\ \%$$

Sampel 12 (Variasi 55°C, 120 Menit)

$$\% \text{ Antioksidan} = \frac{1{,}00680 - 0{,}71806}{1{,}00680} \text{x } 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}28874}{1{,}00680} \text{x } 100 \%$$

$$\% \text{ Antioksidan} = 28{,}6790 \%$$

Sampel 13 (Variasi 45 °C, 90 Menit)

$$\% \text{ Antioksidan} = \frac{0{,}90047 - 0{,}58657}{0{,}90047} \text{x } 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}31390}{0{,}90047} \text{x } 100 \%$$

$$\% \text{ Antioksidan} = 34{,}8596 \%$$

Sampel 14 (Variasi 50 °C, 60 Menit)

$$\% \text{ Antioksidan} = \frac{0{,}90047 - 0{,}36287}{0{,}90047} \text{x } 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}5376}{0{,}90047} \text{x } 100 \%$$

$$\% \text{ Antioksidan} = 59{,}7022 \%$$

Sampel 15 (Variasi 55 °C, 60 Menit)

$$\% \text{ Antioksidan} = \frac{0{,}90047 - 0{,}65272}{0{,}90047} \text{x } 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}24775}{0{,}90047} \text{x } 100 \%$$

$$\% \text{ Antioksidan} = 27{,}5134 \%$$

Sampel 16 (Variasi 45 °C, 90 Menit)

$$\% \text{ Antioksidan} = \frac{0{,}80179 - 0{,}53466}{0{,}80179} \times 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}36581}{0{,}80179} \times 100\ \%$$

$$\% \text{ Antioksidan} = 33{,}3167\ \%$$

Sampel 17 (Variasi 50 °C, 60 Menit)

$$\% \text{ Antioksidan} = \frac{0{,}80179 - 0{,}50207}{0{,}80179} \times 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}3984}{0{,}80179} \times 100\ \%$$

$$\% \text{ Antioksidan} = 37{,}3814\ \%$$

Sampel 18 (Variasi 55 °C, 60 Menit)

$$\% \text{ Antioksidan} = \frac{0{,}80179 - 0{,}7124}{0{,}80179} \times 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}18807}{0{,}80179} \times 100\ \%$$

$$\% \text{ Antioksidan} = 11{,}1488\ \%$$

Sampel 19 (Variasi 45 °C, 90 Menit)

$$\% \text{ Antioksidan} = \frac{0{,}90045 - 0{,}80345}{0{,}90045} \times 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}09702}{0{,}90045} \times 100\ \%$$

$$\% \text{ Antioksidan} = 10{,}7724\ \%$$

KEMENTERIAN RISET, TEKNOLOGI DAN PENDIDIKAN TINGGI
POLITEKNIK NEGERI SRIWIJAYA
LABORATORIUM TEKNIK KIMIA
Jalan Srijaya Negara, PALEMBANG 30139
Telp.0711-353414 ekt. 113 Fax. 0711-355918. E-mail : kimia@polsri.ac.id.

Sampel 20 (Variasi 50 °C, 60 Menit)

$$\% \text{ Antioksidan} = \frac{0{,}90045 - 0{,}8942}{0{,}90045} \text{x } 100\%$$

$$\% \text{ Antioksidan} = \frac{0{,}00627}{0{,}90045} \text{x } 100 \%$$

% Antioksidan = 0,6941 %

Sampel 21 (Variasi 55 °C, 60 Menit)

$$\% \text{ Antioksidan} = \frac{0{,}90045 - 1{,}01240}{0{,}90045} \text{x } 100\%$$

$$\% \text{ Antioksidan} = \frac{-0{,}1119}{0{,}90045} \text{x } 100 \%$$

% Antioksidan = -12,4327 % (tidak terdapat antioksidan)

LAMPIRAN II

DOKUMENTASI

DOKUMENTASI

Daun Binahong yang Masih Segar

Menimbang Daun Binahong Sebanyak 200gr

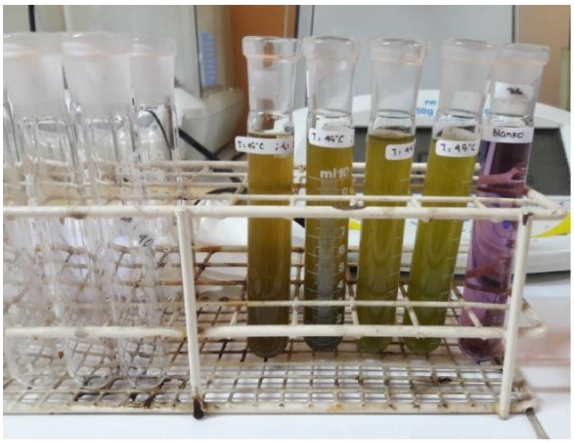
Gula

Blender

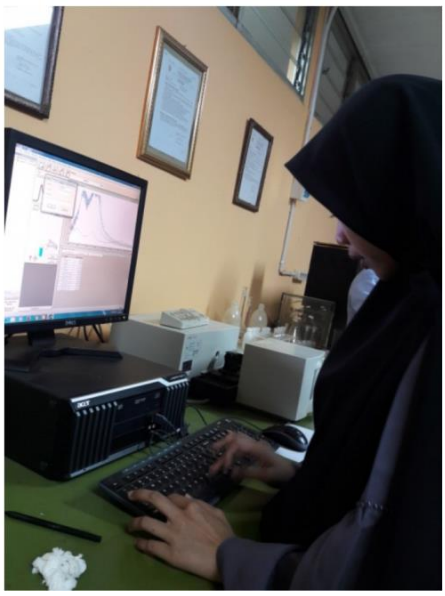
Daun Binahong yang Telah di *Blender*

Persiapan Pemasakan Sirup dengan Vakum Evaporator

Persiapan Sampel untuk Uji Antioksidan



Sampel Sirup Temperatur 45$_o$C yang Akan di Uji



Uji Antioksidan dengan Spektrofotometri UV-VIS

Penambahan Jeruk Kunci

Sirup Daun Binahong

Uji Organoleptik kepada
Para Dosen, Staff dan Politeknik Negeri Sriwijaya